EFFECTING AFFECT:

Developing a positive attitude to primary mathematics learning

Many intelligent people, after an average of 1500 hours of instruction over eleven years of schooling, still regard mathematics as a meaningless activity for which they have no aptitude (Wain, 1994 cited in Westwood, 2000, p. 31).

LEN SPARROW and **CHRIS HURST** remind us of the importance of helping students to develop positive attitudes to mathematics and provide practical suggestions as to how to engage students in a variety of stimulating activities.

Introduction

Most adults' attitudes to mathematics come from their experiences of mathematics in school when they were children. Children's mathematical worlds are complex places containing both cognitive and affective elements. One cannot ignore the affective domain if one wishes to understand children's mathematical learning (Walls, 2001).

Teacher education students consistently use the following words in describing their memories of mathematics. They appear to confirm the general community impression of mathematics in school. Words include:

- repetition
- monotony
- boredom
- not understanding
- mystery
- failure irrelevance
- humiliation.

These memories group into feelings relating to the teaching of mathematics and the teacher education students' personal reaction to themselves as mathematics learners. Boredom and not understanding are two strong emotive reactions to something and provide very good reasons for many people not to engage with mathematics or continue with it when it is not mandated.

Achieving positive emotional responses

Emotions arise as a response to a particular situation (Grootenboer, 2003). Ellerton and Clements (1994) and Way and Relich (1993) noted that an important factor in developing attitudes to mathematics was the emotive response of the person to a situation. As more situations were encountered that led to positive or enjoyable emotive responses, the person's positive beliefs about and attitude to mathematics also grew. The same development, they suggested, is true for negative emotive responses. Each interaction with mathematics confirms (or not) the person's attitude and, in some ways, the person's attitude eventually predisposes the response. Once a cycle of negativity is established, it becomes difficult to break into it with a positive emotive response.

It is also suggested (Hurst, 2008) that children may become more engaged in mathematical learning if the mathematics is embedded in a context that is relevant to them. If children are able to connect their mathematics to such contexts, they might become more motivated, see the value of learning mathematics, learn to apply their mathematics, and ultimately, become analytical users of mathematics.

From our experience, the key factors in achieving positive emotional responses are: variety of experiences, clarity of purpose, and success and understanding for children. Each will be considered before sample activities are suggested.

Variety of experiences

The mathematical diet of children does not have to be one of monotony. Palandri and Sparrow (2009), for example, found that a group of Year 5 and Year 7 children reported that they liked mathematics lessons in Year 3 because they had been provided with a range of things to do. In subsequent years, however, they worked almost exclusively from textbooks and sheets and reported that they disliked mathematics lessons, were bored, and were "over it." Even the children who achieved well in mathematics completed the tasks only because they had to. Other children were less compliant and often failed to finish work or to understand the mathematics being presented.

One response, often suggested to overcome children's boredom with mathematics, is to provide a diet of "fun maths." The suggestion is rarely developed into a coherent set of tasks that develop specific mathematical ideas. In addition, the "fun tasks" are often low-level activities with little or no mathematical focus, such as word searches. These types of task are not helpful but variety can be added to plans and programs by offering a range of:

- tasks — including closed, open, short answer, and extended investigations;
- working styles — incorporating individual, pairs, small group, and whole class;
- grouping combinations — using friends, similar ability, mixed ability, randomly selected peers;
- recording requirements — such as textbook pages, specially prepared sheets, posters, electronic presentation via PowerPoint, oral presentation, written reports;
- ways to learn — using game formats, individual practice of skills and techniques, incorporating technologies, working with software and internet sources, using the interactive whiteboard.

Clarity of purpose

Burns (1995) offered some help and insight when she noted:

> Too often, the rationale for what we do in the classroom isn't obvious to students, and students don't have access to the information. We as teachers must clarify the reasons for our instructional choices and

find ways to make them clear to students so they are informed and motivated.

Many teachers will have heard children groan when a new mathematics task is proposed. They may question why they are doing the task. There is no reason why children should not be told explicitly about the purpose of the tasks that they are asked to do. In particular they should know what important mathematics they will be engaging with and what is intended that they will learn. Teachers in the UK are adopting the acronym WILF (What I'm Looking For) to help children understand what to do and what they might learn (Mooney, Briggs, Fletcher & McCullouch, 2001).

Achieving understanding and success

For too many children the endpoint of their mathematical endeavours has been failure. When people meet repeated failure they tend to stop trying, or give up, and this is exemplified in the mathematics classroom. A self-fulfilling attitude develops: "Everyone expects me not to do very well in mathematics so that is what I'll achieve,"— but with a little thought, the opposite can be accomplished with the expectation of success overtaking that of failure. The key to success appears to be the teacher's expectation and also the teacher setting the task with the "Goldilocks factor," that is, making the challenge for the child "just right." Indeed, this returns to the notion of teachers "knowing their students" and their abilities as is embodied in one example of a Professional Judgement Cycle (Department of Education and Training of Western Australia, 2004). In order to help children achieve success, teachers need to ask themselves the following questions before designing tasks for children:

- What mathematics does the child know now?
- What mathematics does this child need to know next?
- How will I best help this child learn what is needed?

The series of tasks and activities offered below are suggestions for adding variety, being explicit about what is to be learned, providing opportunities for all children to understand and to experience success. All can contribute to students experiencing positive emotional responses to mathematical situations.

Tasks to achieve variety, understanding, and success

Undertaking mathematics learning in a game-like format is attractive to many children. However, there is an important caveat here: to avoid a negative emotive response, beware of too much competition. Children can have a negative response to competition, especially when they are experiencing difficulties with the subject matter. Substituting the competitive element with cooperation may help to achieve a positive response from more children as well as adding variety to the teaching and learning style being experienced.

Competitive to cooperative: Across and down

The first time the game is played, each child plays as an individual. The teacher leads the game to help children understand what they have to do. Each player needs a score sheet (see Figure 1) and a pen/pencil. The teacher has a normal 1 to 6 die. The teacher rolls the die and calls out the selected number. The children place the number in an empty box on their score sheet. The aim is to place the numbers so that the sums of each row and column equal the numbers around the edge of the score sheet. When all nine numbers have been called out the children add the numbers in each row and in each column to see if they are the same as the target number placed at the edge of the sheet. For each correct total the player receives a point.

The children also record the numbers as they appear in the recording row shown in Figure 1. This is used when the focus of

	7	10	6
12			
9			
11			

Die numbers record

Figure 1. Score sheet.

the task changes from being a competitive game for individuals into a cooperative investigation for pairs of children. This investigative, cooperative part of the task requires pairs of students to use the numbers that have been rolled to see if they can be arranged on the same score sheet to achieve a better score than was achieved earlier. As children undertake this activity, the teacher can draw children's attention to the variety of ways in which a number can be broken up (partitioned). This knowledge is very useful when children meet calculations to be completed mentally.

Simulation: Collecting cards

Many children have collected memorabilia cards contained in packaging from purchases such as cereal boxes or from fast food outlets. The latest cartoon feature from the Walt Disney Corporation would be an example where children collect miniatures of each of the characters with their meal purchase.

The task requires pairs of older primary children to design six cards on a theme of their choice, for example Australian Idol contestants (see Figure 2).

Each face of a six-sided die is allocated to represent one of the cards. As the die is rolled, a card is taken each time the equivalent face number shows. For example, face # 3 is matched to Wes Craven. Children tally how many of each card they collect in a chart and from this work out how many "purchases" they might need to make before a full set of collectable cards is gained. If the data from all groups is collected and combined, children can see the range of "answers" generated by the class and also be able to work out average numbers of purchases needed to obtain a full set. As the task unfolds, children's attention can be drawn to the differences in experiential, experimental, and theoretical probabilities, and the factors that impact on them.

1	2	3	4	5	6
Guy Sebastian	Anthony Callea	Wes Craven	Cosima deVita	Kim Cooper	Ricki-Lee Coulter

Figure 2. Cards matched with numbers.

Looping cards

Using open tasks but at the same time setting expectations appropriate to each child is one way to try to help the child achieve success and a positive emotive response to mathematics.

Produce a series of cards cards with format shown in Figure 3.

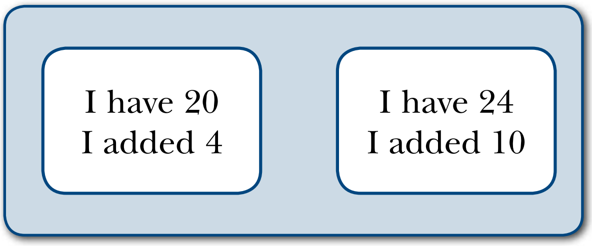

Figure 3. Examples of looping cards.

The next card should start, “I have 24,” (that is, the answer to the previous statement of 20 + 4).

Using this format a set of cards can be produced with the last card having an answer of 20 (to take it back to the starting card). The cards are shuffled and given randomly to children. One person is chosen to read out the first card. The person with the “next” card, i.e., the one with the answer to the previous statement, has to realise it is his/her card and then read it out so that the chain can continue and eventually loop back to the start.

Pairs of children can design their personal sets of looping cards according to the teacher guidelines, for example only using adding and subtracting, or multiplying and dividing. The mathematics learning embedded in the task (“e.g.,” addition and subtraction are inverse operations) should be made explicit to the children as part of the lesson discussion. The task can be set at different levels to suit the challenge needed by the children. Some children will work with smallish numbers and addition and subtraction only. Others may use multiplication and division or even a combination of all operations, larger numbers, or fractions to make the degree of difficulty appropriate.

Patterns in numbers: Skipping numbers

Helping children to see patterns and relationships in numbers (e.g., that multiples of five have a one’s place of five or zero) will be of great help in achieving success when they are calculating and solving problems. For many children, mathematics is a mystery of half-remembered rules and tricks that often they do not understand. In some cases, do not realise the existence of important relationships.

Use the constant setting on a four-function calculator and set it to +5. Ask the children to record the number shown after every (=) key press. Place the numbers in a vertical fashion, one under the other with the ones place in line. Ask the children to describe the patterns they notice in the list.

As the teacher releases control over the task, the children begin to make more decisions and establish their own level of comfort with the size of the numbers and the complexity of the task. A more open but very similar task requires the children to identify a starting number and a stepping number, for example 99 and take away 5, or 3 or multiply by 2. The key-presses and answers are recorded in the same way as the previous example. Through discussion, children’s attention could be focussed on predicting the next element in a pattern, based on what is known about the pattern at that stage.

Rich tasks: How many squares are there in this large chocolate bar?

The initial question relates to Figure 4. The discussion about solving it could focus on several embedded ideas: estimation, repeating patterns and elements, using what is already known to find out what is not known. This style of rich task contains a lot of embedded mathematical thinking and requires children to investigate a situation and to solve a series of problems. Investigating and problem solving bring variety to a mathematics program. Further questions are asked that could be assigned to appropriate pairs of children to match their level of challenge. These are offered below:

> How many squares are there in this large chocolate bar?
> How much does one square weigh?
> Could you share this bar between three people so that each person has the same number of squares?
> Could you share it equally between four people?
> Between 5, 6, 7, 8, 9 or 10 people?
> The chocolate company asks you to design a better bar that is easier to share out between different numbers of people. Draw your design and explain how it is better. (Phillips, 2002)

Conclusion

Employing simple planning techniques, such as adding variety, being clear about the purpose of any activity in mathematics, and ensuring success may lead to more children experiencing positive emotional reactions to their encounters with mathematics in primary classrooms. This in turn may lead to fewer adults regarding mathematics as meaningless and beyond their comprehension. It may also result in more children engaging with mathematics while they are in the classroom because they can see a clear purpose in what they are doing. It may also work to "break the cycle" whereby children are taught mathematics in primary schools by teachers who do not enjoy or have a positive attitude to mathematics.

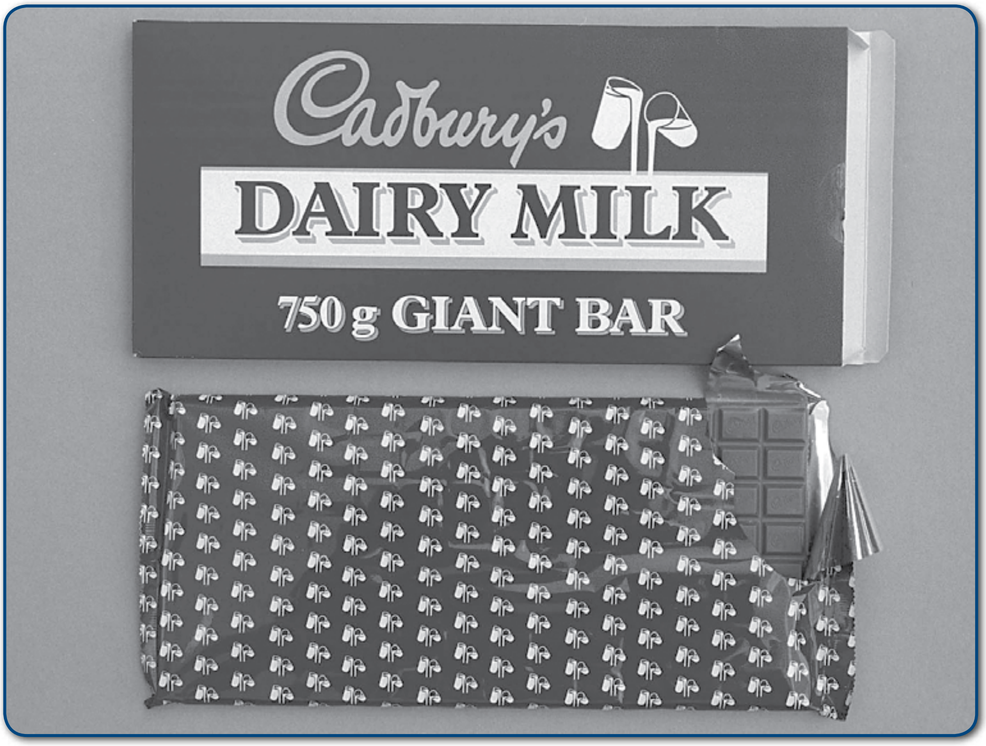

Figure 4. Giant chocolate bar. (This photograph is taken from Problem Pictures published by Badsey Publications and is reproduced here with permission. © Richard Phillips, 2002.)

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Len Sparrow
Curtin University
<l.sparrow@curtin.edu.au>
Chris Hurst
Curtin University
<c.hurst@curtin.edu.au>

APMC